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A REPORT ON RESIDENT FISHING IN THE HAWAIIAN ISLANDS

NATIONAL MARINE FISHERIES SERVICE

Developed by

Meyer Resources, Inc.
Davis, California

ADMINISTRATIVE REPORT

H-87-8C

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Southwest Fisheries Center Administrative Report H-87-8C

This is the final report on a project to determine the economic value of recreational fishing in Hawaii. The study was conducted because of the need by fisheries managers for information on the value of recreational fisheries as well as commercial fisheries, and because of the limited information on the subject. The project was funded by the Southwest Fisheries Center annual research program as NOAA Contract NA46-0001.

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This report was prepared under contract. Therefore the conclusions, findings, and recommendations are those of Meyer Resources, Inc. and do not necessarily reflect the views of the National Marine Fisheries Service.

James H. Taylor
Executive Director

March 1987

NOT FOR PUBLICATION

PREFACE

This is the final report on a project to determine the economic value of recreational fishing in Hawaii. The study was undertaken because of the need by fisheries managers for information on the value of recreational fisheries as well as commercial fisheries, and because of the intrinsic interest of the subject. The project was funded by the Southwest Fisheries Center economic research program as NOAA Contract 84-ABC-00105.

The question of measuring the economic value of resources which are not sold in markets, such as recreational fish, is a difficult conceptual and practical problem. This is particularly difficult in Hawaii where there is no clear delineation between commercial and recreational fishing. Meyer addresses these issues in the context of introducing the project design and in discussing the results.

Meyer's research approach involves a number of items which are relatively unique to Hawaii. These include the use of the "key respondent" technique for estimating values for recreational fishers and the use of the "fair value" concept in economic valuation. Discussion of these techniques is a part of this project.

Meyer finds the total non-market value of recreational fishing (from boats) in Hawaii to as much as \$239 million from direct expenditures of \$24 million. Sales of fish by "recreational" fishers is estimated at 10 million pounds, valued at \$22 million, and total catch by recreational fishers is estimated at 21 million pounds. These are substantial numbers for Hawaii, especially when compared to recorded commercial fish landings of 8.4 million pounds in 1985, worth \$16.7 million. Meyer points out that the basis for these average values and their extrapolation is tentative and subject to further investigation. Readers will want to scrutinize the methodology used by Meyer and other researchers in developing catch numbers and economic values for fisheries in Hawaii but we believe this report is an important contribution to understanding the tremendous value placed on "recreational" fishing by people in Hawaii.

This report was prepared under contract. Therefore the statements, findings, conclusions and recommendations are those of Meyer Resources Inc. and do not necessarily reflect the views of the National Marine Fisheries Service.

Samuel G. Pooley
Industry Economist

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I. Objective of the Report

The principal objective of this report is to assemble available information on the economic significance, in both market and non-market terms, that residents of Hawaii associate with non-commercial fishing. Market value refers to circumstances where catch is exchanged for dollars in either formalized or non-formalized transactions--as well as to the expenditures a fisherman associates with his or her fishing activity. Non-market value refers to the worth that fishermen associate with their activity over and above dollars received or spent. The term "resident fisherman" refers to persons who are not making their primary living from commercial fishing. In other jurisdictions, such persons might be described as recreational fishermen. In the Hawaiian Islands, however, any citizen may purchase a license for five dollars, enabling him/her to sell fish. This makes a sharp distinction between recreational and commercial fishing less meaningful. The resident fisherman, as defined here, will fish for enjoyment, own consumption, to obtain cash to defray boat expenses, and for a variety of other purposes, but not to obtain his or her primary source of income.

Several secondary objectives are also considered in this report.

- identification of the satisfactions residents of the Hawaiian Islands associate with fishing;
- identification of the variety of uses to which catch is put;
- identification of accessing points (ie. harbors and ramps);
- estimation of catch by species;
- estimation of effort;
- identification of fishermen attitudes and perceptions related to boating facilities and a range of other fish/boating issues in Hawaii.

This report targets information on resident fishing from four islands, Oahu, Hawaii (hereafter, the Big Island), Maui and Kauai, comprising over 99 percent of the State's population.

II. Information Development Procedures

A reasonably accurate data set is available on vessel ownership in the Hawaiian Islands¹. Further, Samples, et. al. have developed data on Hawaii's charter fishing fleet², while SMS Research conducted some exploratory work in valuing resident boater fishing³. However, no comprehensive, statistically integrated, data set from which to derive targeted resident fishing values exists for resident fishermen in the Hawaiian Islands.

The initial project outline called for a detailed and extensive mail survey of boat fishermen in Hawaii. However, because of constraints imposed on the project design, this objective could not be fulfilled. Therefore, it was determined to utilize an expanded "key respondent" technique to develop the information we sought, and to backcast where possible to compare the key respondent information to that previously existing. Key respondents are often used to obtain information in anthropological and social scientific enquiries.

-
1. State of Hawaii, Department of Transportation.
 2. Samples, Karl C., J.M. Kusakabe and J.T. Sproul, A Description and Economic Appraisal of Charter Boat Fishing in Hawaii. Southwest Fisheries Center Admin. Report H-84-6C, Honolulu, April, 1984; Samples, Karl C. and D.M. Schug, Charter Fishing Patrons in Hawaii: A Study of Their Demographic Motivations, Expenditures and Fishing Values, Southwest Fisheries Center Admin. Report H-85-8C, Honolulu, May, 1985.
 3. SMS Research, Experimental Valuation of Recreational Fishing in Hawaii. Southwest Fisheries Center Admin. Report H-83-11C, Honolulu, June, 1983.

Zelditch suggests that key respondent procedures often prove sufficiently reliable to approximately replicate results from survey sampling--particularly for questions involving enumeration, or for those concerning what people do now, or did in the past⁴. Following Zelditch, this type of information, provided by key respondents, is not just individual opinion, but is in some sense an objective measure of group values. However, he adds, eliciting information about key respondents themselves is a suspect way of using the key respondent procedure, unless the key respondents can be seriously thought of as representatives of their group.

With the above concerns in mind, the following procedure was used to develop information for the present analysis.

1. Fishing clubs on the four main Hawaiian Islands were identified and their Presidents were contacted during the last quarter of 1985.
2. A meeting was held with each President, and usually one or two other club members. At the meeting, information sought for this report, and issues and concerns of club members were discussed.
3. On the basis of (2) above, and after consultation with NMFS, a discussion outline was prepared. This outline was constructed to provide a balance of principal topics between what Meyer Resources, Inc. (MRI) wished to talk about, and what each fishing club wanted to talk about. The discussion list is presented on the next page (Table 1).

4. Zelditch, Morris Jr. "Some Methodological Problems of Field Studies" in Franklin and Osborne (eds), Research Methods: Issues and Insights. Wadsworth Publishing Co. Belmont, CA, 1971, pp. 228-244.

Table 1Discussion Outline for Club MeetingsMRI Topics

- Dollars spend on fishing
- Value of an hour's fishing over and above expenses
- Description of the fishing trip
- Disposition of catch
- Description of catch
- Reasons for fishing

Fishing Club Topics

- Facilities needed at launching ramps
- Facilities needed at harbors
- Fueling facilities required in the Islands
- Fishing methods that should not be allowed
- Opinions on whale sanctuaries
- Facilities and issues re. shore fishing

4. Mr. Meyer was then invited as the "entertainment" at a regular meeting of each fishing club. Somewhere between 6 and 30 members or guests were usually present. Each issue was discussed, with those members who wished to, writing opinions and information on an accompanying discussion guide. In some instances, information was sent to MRI by club members subsequent to the meeting. Information gathered referred to the 1985 fishing year. This task was accomplished in the January through March period, 1986.
5. MRI then integrated the information received, subjected it to an initial computer analysis, and printed out "results" for each topic of interest.
6. In the last quarter of 1986, MRI then sent the information derived from each club back to the club, to verify that it was "representative".

7. Follow-up communication ensued, and information developed in the initial key respondent round of discussion was adjusted where required. Steps (6) and (7) thus fulfilled the conditions for "representativeness" outlined by Zelditch (pg. 3).

In this manner, "representative" information was developed for 15 boat fishing clubs and two shore fishing clubs on the 4 main Hawaiian Islands. A listing of these clubs follows (Table 2). Nine persons with no club affiliation, and fishing the windward side of Oahu also responded to the issues identified. Two clubs, Pokai Bay on Oahu and Kona Iki, on the Big Island, invited me to a meeting--but not enough information was obtained to have confidence in the representativeness of results. The Maui Coop. is primarily a club for commercial fishermen. Information from that club is included in most tables, but is not integrated into Maui or statewide totals, except where considered appropriate.

Table 2

Responding Fishing Clubs - Hawaiian Islands

<u>Island</u>	<u>Club</u>	<u>Main Type of Fishing</u>
Oahu	Aiea	Boat fishing
Oahu	Haleiwa	Boat fishing
Oahu	Honolulu Mosquito Trollers	Boat fishing
Oahu	Kaneohe	Boat fishing
Oahu	Keehi	Boat fishing
Oahu	Pearl Harbor	Boat fishing
Oahu	Waialua	Boat fishing
Big Island	Hilo Casting	Shore fishing
Big Island	Hilo Trollers	Boat fishing
Big Island	Kona Casting	Shore fishing
Big Island	Kona Mauka	Boat fishing
Maui	Maalaea	Boat fishing
Maui	Maui Coop.	Boat fishing
Kauai	Kukuila	Boat fishing
Kauai	Westside Commercial and Sport Fishing Club	Boat fishing

III. Representativeness of Information Developed

As noted, under the key respondent procedure adopted here, we are reasonably confident that information received is representative on a fishing club by club basis. Two broader questions remain. First, can the information received be considered representative of all fishing clubs on a broader island by island basis, or across the State of Hawaii? Second, is information developed from fishing clubs members representative of resident fishermen in the Hawaiian Islands as a whole? Differences in informational results might be expected on the basis of geographic location, income, age or a variety of other demographic characteristics. It must be emphasized, however, that differing status between fishing sub-groups is not, in itself, sufficient to indicate differences in information response. Rather demographic or other sub-group characteristics must also "predict" with respect to information received.

Sufficient information exists to evaluate demographic differences between clubs, and, because of the single island constituency of each club, between islands⁵. Only limited data exists, however, describing the characteristics of boat and shore fishermen as a whole in the Hawaiian Islands. Discussion of potential representativeness with respect to the boat fishing/shore fishing population in general must therefore proceed inferentially. These issues will be considered further during presentation and discussion of informational results.

5. Skillman, Robert A. and David K.H. Louie, Inventory of U.S. Vessels in the Central and Western Pacific. Southwest Fisheries Center Administrative Report H-84-12, NMFS. Honolulu, 1984, suggest that approximately 11 percent of fishermen in the Hawaiian Islands belong to clubs.

IV. Presentation and Discussion of Information

1. Introduction

Because the information presented here is developed by aggregating individual perceptions of several club members into a "club representative" information set, information aggregation procedures are not always obvious. In some cases, it will be most efficient to rely on the information provided by individual key respondents. In other instances, "by club" analysis will seem more reliable. Further, aggregation choices are available at club, island and state of Hawaii levels. It will consequently be necessary to consider aggregation choices for each informational characteristic discussed in this report. While available information will vary across topics discussed, basic choices are outlined in Table 3.

Table 3

Basic Representative Information Units
Available as a Basis for Analysis

<u>Aggregation</u> <u>Designation</u>	<u>Units of Information Available</u>		
	<u>By Club</u>	<u>By Island</u>	<u>By State</u>
<u>A. Oahu</u>			
Pearl Harbor Club	6		
Haleiwa Club	5		
Aiea Club	16		
Waialua Club	31		
Keehi Club	22		
Kaneohe Yacht Club	22		
Honolulu Mosquito Club	16		
Pokai Bay ⁽¹⁾	2		
Oahu - at large fishermen	9		
All Oahu boat fishermen		129	
All Oahu boat clubs		7	
<u>B. Big Island</u>			
Hilo Casting Club	16		
Kona Iki Club ⁽¹⁾	1		
Hilo Trollers Club	25		
Kona Mauka Club	8		
Kona Casting Club	13		
All Hawaii Boat fishermen		34	
All Hawaii Shore fishermen		29	
All Boat Clubs		2	
All Shore Clubs		2	

(cont'd on pg. 9)

Table 3 (cont)

<u>Aggregation Designation</u>	<u>Units of Information Available</u>		
	<u>By Club</u>	<u>By Island</u>	<u>By State</u>
<u>C. Maui</u>			
Maalaea Boat Club	31		
Maui Fisherman's Coop	10		
All Maui Boat Fishermen ⁽²⁾		31	
All Maui Boat Clubs ⁽²⁾		1	
<u>D. Kauai</u>			
Kukuiula Club	14		
Westside Club	10		
All Kauai Boat fishermen		24	
All Kauai Boat clubs			2
<u>E. State of Hawaii</u>			
All boat fishermen			218
All shore fishermen			29
All boat clubs			12
All shore clubs			2

(1) Not enough information was developed to support analysis.

(2) The Maui Coop. is extensively involved in commercial fishing. It is described in this report, but "resident fishing" results for the island of Maui are based on the Maalaea Club only.

2. Expenditures by Resident Sport Fishermen in the Hawaiian Islands

a) Boat Fishing

i) Information at the Club Level

Boat fishing costs per trip were developed by expense item for each club, and then added to a total. Amortization of the boat was not included. Individual response data was quite limited for some clubs (see Table 3), so that, in those cases, 95 percent confidence intervals for itemized expenses sometimes encompassed zero. On this basis, it was concluded that reporting of individual expense items, by club, would not be reliable. Our follow-up procedure with clubs did, however, indicate that the "total expenses" information we developed was likely "representative" for each club. This information is indicated in Table 4.

Table 4

Total Expenses per Boat Fishing Trip, By Club
Resident Hawaii Fishermen

<u>Club</u>	<u>Estimated Total Expenses per Trip</u> \$
<u>A. Oahu</u>	
Aiea	97.76
Haleiwa	118.40
Honolulu Mosquitos	129.45
Kaneohe	105.58
Keehi	128.11
Pearl Harbor	107.40
Waialua	85.39
<u>B. Big Island</u>	
Hilo Trollers	134.47
Kona Mauka	111.15
<u>C. Maui</u>	
Maalaea	187.28
Maui Coop(1)	178.82
<u>D. Kauai</u>	
Kukuiula	106.50
Westside	125.33

(1) Primarily a commercial fishing group.

This information suggests relatively little difference in total boat fishing costs between clubs, although boat fishers on Maui may spend more than elsewhere. Results for the 9 "at large" fishermen we talked to on the windward side of Oahu were lower, averaging out at \$67 per trip. We have no method of assessing what sub-group, if any, these results are representative of, and will not use them further in analysis.

ii) Information at the Island Level

To make any reliable, by island comparisons, information needs to be further analyzed. Table 5 identifies cost expense information, by island and by item. As the Maui Coop is essentially a commercial fishing group, only Maalaea data is used for Maui. Based on the key respondent information provided, both mean values and standard deviations are provided. Ninety-five percent confidence intervals for each mean are provided beneath each mean in parenthesis, rounded to the nearest dollar. It can be observed that aggregation of club information makes resulting expenditure estimates appear more reliable. Such aggregation is most noticeable for data from Oahu and Hawaii. As information from only one fishing club was used on Maui, aggregation had no effect there.

Table 5
Total Expenses Per Boat Fishing, Trip, by Island
Resident Hawaii Fishermen

Boat Fishing Expense Item	Oahu		Big Island		Maui (1)		Kauai	
	Mean Expense	Standard Deviation	Mean Expense	Standard Deviation	Mean Expense	Standard Deviation	Mean Expense	Standard Deviation
Fishing Gear	22.54 (+/- 6)	32.29	29.26 (+/- 11)	30.90	28.71 (+/- 17)	40.36	18.42 (+/- 8)	17.54
Food & Beverages	13.80 (+/- 2)	8.26	16.06 (+/- 3)	9.35	33.19 (+/- 15)	35.44	12.47 (+/- 5)	11.97
Ice	9.79 (+/- 2)	12.78	8.74 (+/- 2)	5.94	26.19 (+/- 28)	64.49	10.05 (+/- 6)	12.83
Bait	7.02 (+/- 2)	8.29	10.66 (+/- 3)	8.85	9.24 (+/- 7)	16.40	10.42 (+/- 9)	18.95
Boat Fuel	39.39 (+/- 5)	29.43	57.44 (+/- 11)	31.81	65.43 (+/- 48)	111.13	40.79 (+/- 7)	31.95
Car Fuel	7.01 (+/- 1)	6.81	7.69 (+/- 2)	4.45	18.90 (+/- 28)	65.00	9.16 (+/- 6)	13.47
Other	4.38 (+/- 2)	9.94	5.00 (+/- 2)	10.68	5.62 (+/- 5)	12.11	14.11 (+/- 15)	32.25
Total Expense	\$103.93		\$134.85		\$187.28		\$115.42	

(1) Based on Maalaea only.

* (+/-) indicates the range of the 95 percent confidence interval.

iii) Information at the State Level

Aggregation of information on a state-wide basis is presented in Table 6. Again, mean values, associated standard deviations and confidence intervals are provided.

Table 6

Total Expenses Per Boat Fishing Trip - State of Hawaii Resident Fishermen

<u>Expenses Item</u>	<u>Mean Value</u> \$	<u>Standard Deviation</u> \$
Fishing Gear	23.96	33.13
Food and Beverages	16.27	15.68
Ice	11.52	25.11
Bait	8.26	11.06
Boat Fuel	45.65	18.30
Car Fuel	8.71	23.80
Other Expenses	5.64	14.36
Total Expenses	<u>\$120.01</u>	

iv) Comparison with Other Expenditure Data for Boat Fishermen

SMS Research reported 1983 average per trip costs of \$104, based on random sampling of persons launching trailered boats at Waianae (Pokai Bay) Small Boat Harbor⁶. This result, which did not segregate boating club members from non-club members, included a \$12 dollar per trip boat amortization item, not incorporated in our 1986 results. However, considering the passage of 3 intervening years, and the \$104 per trip expense reported for Oahu in Table V of this report, results seem closely analogous.

⁶. SMS Research, op. cit.

v) Conclusions Concerning Expenses per Resident Boat Fishing Trip in the Hawaiian Islands

On the basis of the previous discussion and reported results, it is our impression that the expenses identified in Table 4 are likely "representative" at club levels. Further, comparison of Oahu total expense estimates with those from SMS, seems to support a tentative hypothesis of no significant difference in per trip expenses between boat fishing club members and non-club members in the Hawaiian Islands. We consequently believe that Tables 5 and 6 also present estimates of per trip expenditure that are improved over those previously available. While we are fairly confident with respect to these data, expenses per trip do differ somewhat by island, and by club sub-group.

b) Shore Fishing

As noted, information on shore fishing was only developed for the Big Island. Estimated expenses per trip, based on discussion with two Big Island shore fishing clubs, is presented in Table 7.

Table 7Estimated Shore Fishing Expenditures on the Big Island

<u>Expense Item</u>	<u>Expenditures per Trip</u>	
	<u>Hilo</u>	<u>Kona</u>
	<u>Casting</u> \$	<u>Casting</u> \$
Transportation	25.14	10.27
Ice	4.71	10.00
Bait	5.71	4.00
Fishing Gear	21.62	15.00
Food and Beverages	27.81	20.00
Other Expense	5.24	.45
Total Expense	<u>\$90.23</u>	<u>\$59.72</u>

These data are limited. Estimates between clubs diverge, and may represent a range of possible shore fishing expenditures over trips with varying characteristics. As might be expected, however, shore fishing costs are less than those developed for boat fishing.

3. The Non-Market Value of Resident Sport Fishing in the Hawaii Islands

a) Discussion of Concepts

As noted, in Section I, the value of recreational fishing to participants often exceeds what they actually pay. This is due to a number of factors. Market prices may not be structured to capture every last cent each participant would be willing to pay to fish, and do not adequately indicate compensation participants would consider fair if fishing opportunity was preempted; fishermen may live close to the fishing site, so that travel costs are minimal; expenditures don't capture the value of time expended in going fishing, and so on. Thus, market value does not equal total value for fishing, and an additional component, termed "non-market value" must be added in if the values of fishermen are to be fully represented.

Failure to consider additional non-market values in resource decision-making will distort results in a number of ways. First, the benefits associated with facilities supporting resident fishing will be understated, relative to their costs of construction and operation. Second, the value of protecting and enhancing fisheries will be underestimated, relative to competing activities that primarily produce products valued in the economic market place. Third, failure to adequately consider non-market values will direct fishing programs toward generating dollar returns and away from the enhancement of non-dollar public benefits. In the Hawaiian Islands, where access to marine fishing has traditionally been

free, these are significant concerns. It is consequently necessary to estimate both market and non-market values associated with resident fishing.

Economists typically estimate non-market values by attempting to simulate what would occur if there was an economic market that extracted all the value from resident fishermen. Markets are created when buyers who will purchase various amounts of goods or services at each of a series of possible prices (in geometric terms, the demand curve) interact with sellers, who will sell various amounts of goods or services at each of a series of possible prices (the supply curve). The lower the price, the more people will want to buy the good. The higher the price, the more people will be willing to sell it. At some point, exactly the same number of buyers and sellers will interact at a single price, determining both market price and market quantity. This is the process that economists working in the non-market area set out to simulate.

The majority of traditional market simulations have focussed on specification of the demand for fishing. Such specification has involved two general lines of inquiry, direct questioning of what respondents might be willing to pay for fishery benefits, or estimates of the relationship between expenses actually incurred and participation in fishing. The former direct procedures are most often characterized as "willingness to pay", the latter as "travel cost", or some augmented variant such as hedonic evaluation. According to economic theory, valuation of fisheries based upon simulated

demand is clearly most appropriate when considering an increase in welfare due to enhanced fishery benefits⁷. Such enhanced benefits may occur as the result of an overall improvement in fishery stocks, where, presumably, all user groups may benefit to some degree, or from the reallocation of existing stocks from users of lower value to users of higher value. In the latter case, and without establishment of a property right, it has been traditional in economic theory to consider all user groups as bidders, with allocation decisions based on highest valued use or uses.

Significant advances have been made in both direct and indirect estimation of demand curves applicable to non-market fishery (and wildlife) benefits. Early direct willingness to pay work in the Pacific Northwest was conducted by Hammack and G. Brown, Jr.⁸, by G. Brown, Jr., Charbonneau and Hay⁹, and by Crutchfield and Schelle¹⁰. Further important improvements in bias management associated with direct simulation of non-

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7. A general discussion of welfare criteria associated with gainers and losers affected by reallocation of resources may be found in H.H. Liebhafsky, The Nature of Price Theory, Chapt. 16. Dorsey Press, Homewood, ILL. 1963.
 8. J. Hammack and G.M. Brown, Jr., Waterfowl and Wetlands: Toward Bioeconomic Analysis. Baltimore: John Hopkins Press, 1974.
 9. G.M. Brown, Jr., J.J. Charbonneau and M.J. Hay, Estimating Values of Wildlife: Analysis of the 1975 Hunting and Fishing Survey, Working Paper No. 7, U.S. Fish and Wildlife Service, 1978.
 10. J.A. Crutchfield and K. Schelle, An Economic Analysis of Washington Ocean Recreational Salmon Fisheries with Particular Emphasis on the Role Played by the Charter Vessel Industry. U. of Washington, Dept. of Economics, Seattle, 1979.

market values have been achieved, particularly at the Universities of Wyoming and Wisconsin¹¹.

Indirect valuation of non-marketed resources has also improved substantially in the past two decades, via travel cost and augmented travel cost approaches, including hedonic evaluation of fisheries. W.G. Brown, et.al. reported travel cost work in the Pacific Northwest as early as 1964¹², and has published a number of travel cost and augmented travel cost evaluations since¹³. Donnelly, Loomis and Sorg¹⁴ have also developed recent data for Idaho using both direct and indirect evaluation methods. G.M. Brown, Jr. reported on hedonic

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11. For a review of this work, see R.G. Cummings, D.S. Brookshire, W.D. Schulze and D.L. Coursey, Valuing Environmental Goods: A State of the Arts Assessment of the Contingent Valuation Method. Rowman and Allanheld, Totawa, N.J., 1986.
 12. W.G. Brown, A. Singh and E.M. Castle, An Economic Evaluation of the Oregon Salmon and Steelhead Sport Fishery, Oregon Agricultural Experiment Station Technical Bulletin 78, Corvallis, Ore. 1964.
 13. W.G. Brown, D.M. Larson, R.S. Johnston and R.J. Wahle, Improved Economic Evaluation of Commercially and Sport-Caught Salmon and Steelhead of the Columbia River, Oregon Agricultural Experiment Station, Corvallis, Ore. 1976; W.G. Brown, C. Sorhus and K.S. Gibbs, Estimated Expenditures by Sport Anglers in the Pacific Northwest, Department of Agricultural Resource Economics, Oregon State University, 1980; W.G. Brown, C. Sorhus, B. Chou-Yang and J. Richards, "Using Individual Observations to Estimate Recreational Demand Functions: A Caution", American Journal of Agricultural Economics, Vol. 65, No.1, Feb. 1983, pp. 154-157; P.A. Meyer, W.G. Brown and C. Hsiao, An Updating Analysis of Differential Sport Fish Values for Columbia River Salmon and Steelhead, a report to NMFS, Portland, June, 1983.
 14. D. Donnelly, J. Loomis and C. Sorg, The Net Economic Value of Recreational Steelhead Fishing in Idaho, Rocky Mountain Forest and Range Experiment Station, U.S. Forest Service, Fort Collins, September, 1983.

evaluation of Northwest fisheries, using a travel cost based technique in 1978¹⁵, and again in 1981¹⁶.

Reviewing these studies, and others, it can be concluded that methods for simulating demand curves for non-market goods and services, via either direct procedures or by indirect travel cost based procedures, are well advanced--and that choice of procedure will likely not be determined by relative theoretical soundness, but by applied circumstance. Indirect methods for simulation of demand curves avoid strategic behavior potentially displayed by respondents when hypothetical questioning is employed. However, demand estimation based on travel cost will not provide a fully comprehensive estimate of fishery values where fishermen's homes are too close to fishing destinations, so that travel cost becomes a poor indicator of relative value and of participation. This is believed to be the case in Hawaii¹⁷. Here, one can predict that travel cost based demand curve estimates that focus on residents of coastal areas and consider nearby marine fisheries will produce lower value estimates than studies of residents in areas where source/destination separation is likely greater and more distinct.

15. G.M. Brown, Jr., Valuation of Non-market Natural Resources with a Hedonic Technique. Univ. of Washington, Seattle, 1978.

16. G.M. Brown and R. Mendelsohn, The Hedonic Travel Cost Method: A New Technique for Estimating the Recreational Value of Site Characteristics, A report to the U.S. Dept. of Interior, University of Washington, Seattle, 1981.

17. SMS Research, op. cit.

Just as non-market economic methodology requires simulation of demand curves to evaluate fishery improvements, it is equally clear that economic theory requires simulation of supply curves to estimate the value of fishery losses¹⁸. The earliest willingness to sell (compensatory) estimate for salmon and steelhead was estimated by Mathews and Brown in 1967 in the Pacific Northwest¹⁹. More recently, Crutchfield and Schelle²⁰ (1979) produced a compensatory estimate for Washington state sport fishing, while Meyer Resources (1980; 1982) developed a compensatory estimate for selected groupings of fish and wildlife in California's Central Valley²¹, and a similar estimate for upper Columbia River salmon and steelhead²². Ownership rights in fisheries further strengthen the rationale for compensatory evaluation. In the Pacific Northwest, Indian fishery rights

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18. W.K. Desvouses, V.K. Smith and M. P. McGivney, A Comparison of Alternative Approaches for Estimating Recreation and Related Benefits of Water Quality Improvements. Research Triangle Institute, Triangle Park, N.C. EPA Contract No. 68-01-5838, 1983; D.H. Huppert, NMFS Guidelines on Economic Evaluation of Marine Recreational Fishing. NOAA Technical Memorandum NMFS-SWFC-32, June, 1983. The Bay Institute of San Francisco, Proceedings of a Workshop on Economic Non-Market Evaluation of Losses to Fish, Wildlife and Other Environmental Resources, (forthcoming).
 19. S.B. Mathews and G.S. Brown, Economic Evaluation of the 1967 Sport Salmon Fisheries of Washington. Technical Report No. 2, Washington Department of Fisheries, Olympia, 1970.
 20. J.A. Crutchfield and K. Schelle, op. cit.
 21. P.A. Meyer, Recreational/Aesthetic Values Associated with Selected Groupings of Fish and Wildlife in California's Central Valley. A Report to the U.S. Fish and Wildlife Service, Center for Natural Areas, Sacramento, CA. 1980.
 22. Meyer Resources, Inc. Recreational/Aesthetic Values Associated with Salmon and Steelhead of the Columbia River, A Report to the U.S. Bureau of Indian Affairs, Portland, May, 1982.

provide an obvious example²³. Further, state agencies with restoration responsibilities for fish and wildlife have successfully recovered compensatory damages for losses caused by pollution²⁴. Finally, recent adjudication of the Mono Lake case in California, referencing doctrine of the Public Trust, assigns public rights to natural resources co-equal importance with private rights²⁵.

Compensatory evaluation to date has proceeded via direct hypothetical questioning, and consequently may be subject to respondent biasing concerns. As with direct estimation of demand, however, work by a number of economists provides a useful array of bias management techniques that are available to the economic analyst²⁶. Consequently, while fewer compensatory studies have been done, and while direct willingness to pay questioning may elicit some downward bias while direct willingness to sell (ie. compensatory) questioning may elicit some upward bias, techniques for bias reduction can now contain such distortion to the point where direct estimation of fishery values can be usefully applied for a range of purposes.

23. U.S. District court, United States v. Washington, filed in Tacoma, Sept. 18, 1970.

24. F. Halter and J.T. Thomas, "Recovery of Damages by States for Fish and Wildlife Losses Caused by Pollution", Ecology Law Quarterly, Vol. 10-5, 1982, pp. 5-35.

25. "National Audubon Society vs. Superior Court", 33 Cal, Supreme 3-D, 5-4109; For a general discussion of the implications of public trust for resource management, see H.C. Dunning (ed.), The Public Trust Doctrine in Natural Resource Law and Management. School of Law, University of California, Davis, 1981.

26. See Note (10).

In reviewing the range of approaches previously discussed, and circumstance in the Hawaiian Islands, a number of conclusions seem evident.

- i. The basic character of management decisions where developed value data might be utilized involves fishery resource enhancement and/or re-distribution. Consequently, compensatory estimation will not be a central concern for this analysis.
- ii. Hawaiian Island residents live relatively close to their fishing, and utilize a variety of accessing points and facilities to seek out a variety of fish. Meyer Resources, Inc. concurs with SMS Research²⁷ that a travel cost based value simulation may not provide distinct product values and will likely provide a significant underestimate of the non-market value of resident fishing in Hawaii. Consequently, a direct simulation of resident fishing value is preferred.

We therefore concluded that key respondents should be asked to directly simulate a non-market value for resident fishing.

b) Framing the Value Question

Boaters in the State of Hawaii enjoy a strong tradition of free public access to fisheries--and there is no sport fish license in the state. To ask what fishermen would be "willing to pay" for a given increment of fishing is totally foreign to existing circumstance in Hawaii--and could confidently be predicted to result in major levels of non-compliance, both with that question and with our other enquiries. Equally important, results from such a "willingness to pay" approach would be meaningless to any real Hawaii context. We therefore needed to develop a question framing approach that was more consistent with Hawaiian Island circumstance. Kahneman and Tversky have noted that symmetry between question framing and

27. SMS Research, op. cit.

the valuing context that respondents consider appropriate is potentially important to a reliable contingent value response²⁸.

In attempting to develop more appropriately framed non-market valuation procedures, and to deal with the economist's concern that willingness to pay (WTP) questions produce biased underestimates while willingness to sell (WTS) questions produce biased overestimates²⁹, we discovered in previous work that if questions were framed to seek a "fair value", responses fall between the WTP and WTS extremes³⁰. The theoretical implications of introducing an equity concept such as fairness--virtually ignored until recently by economists--are still being developed. Baumol, in a major recent work, provides important insight for a theory of fairness, and "fairness improvement", and relates his findings to the Pareto improvement theory of more conventional economics³¹. Thaler notes that the perceived "merits" or "demerits" of a transaction will increase/decrease total utility, and goes on to indicate that the most important determinant of a "just

28. Kahneman, Daniel and A. Tversky, "Prospect Theory: An Analysis of Decision Under Risk", Econometrica, March, 1979, 263-291.

29. Bishop, Richard C. and T.A. Heberlein, "Measuring Values of Extra-Market Goods: Are Indirect Measures Biased?" American Journal of Agricultural Economics, 1979, Vol. 61, no. 5, 926-930.

30. Meyer Resources, Inc. "Values for Fish, Wildlife and Riparian Resources", in Economic Evaluation of River Projects. A Report to the California Resources Agency, 1982. Vol. III.

31. Baumol, William J. Superfairness. The MIT Press, Cambridge, Mass, 1986.

price" is fairness³². Brown argues that assigned values are a function of fundamental or "held" values (in which "honesty" plays a large role), preferences and social relationships³³. Under this line of reasoning, a theory that deals only with unconstrained personal preferences will be incomplete. Finally, Kahneman, Knetsch and Thaler identify circumstances where opportunity for retaliation based on concepts of "what is fair" apparently constrain the actions of firms operating in real markets³⁴. Consistent with this developing theory, with empirical evidence that concepts of fairness dampen bias from unconstrained willingness to pay, questioning, and with actual circumstances experienced by Hawaii's fishermen, it was consequently decided that inquiry as to a "fair non-market value" for fishing had the best chance of simulating actual assigned values, to use Brown's term (Note 33), that would occur in a real market.

c) Specifying the Fishing Product

Simulation of non-market economic value for fisheries can specify a range of "products" to be valued--a fish, an hour of fishing, a recreation day, a trip, a month's recreation, a year's recreation, and so on. Because the present analysis targeted marginal effects of fisheries management, it was clear that relatively small product size was most appropriate.

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32. Thaler, Richard, "Mental Accounting and Consumer Choice" Marketing Science, Summer, 1985, 4:3, 199-214.
 33. Brown, Thomas C. "The Concept of Value in Resource Allocation". Land Economics, August, 1984, 60:3, 231-246.
 34. Kahneman, Daniel, Jack L. Knetsch and Richard Thaler "Fairness as a Constraint on Profit Seeking: Entitlements in the Market", American Economic Review, Vol. 76, no. 4, pp. 728-741.

d) Making Non-Market Valuation Understandable

Discussants often find the concept of non-market value novel, and it is desirable to anchor their response in some context that is familiar to them. Considering this issue, key respondents were encouraged to first consider what they could obtain in the market for one hour of work (ie. their wage). They could then use that number as a reference point in developing a value estimate for an hour of fishing.

e) The Actual Question

Referencing the issues just discussed, the following two step inquiry was put to key respondents.

Some fishermen place a value on fishing over and above what they spend on it--and dollars are often used to measure this additional value, even though it's a personal value for the fisherman, and is not bought, sold or charged for.

If we are to properly and fully value sport fishing activities, we need your best estimate in dollars of this additional value. To help you think of these benefits in dollar terms, you might think of what your sport fishing time is worth to you. Do you value your fishing time at the same level you get paid for your time when you work? Is it worth more to you? Is it worth less?

Now, on the kind of trip you take most often, what value, if any, over and above actual trip costs, would you associate with an hour of fishing?

\$/hr.

Fair value for an hour of boat fishing

In sum, simulation of non-market values for fishing is complex. We believe that considering the need to fit enquiry to the circumstances of Hawaii's resident fishermen, and foregoing conceptual discussion, the non-market value results reported in the next section for Hawaii's fishermen are reasonable. Further, given their relative symmetry, on an island by island basis, it is not clear that means would change significantly in a formal randomized survey, although variances would likely decline.

Finally, we also sought marginal values, by asking key respondents who indicated an average value for a hour of fishing, to then indicate how that value would change if catch was reduced to half current levels.

f) Non-Market Values for Resident Boat Fishermen in the Hawaiian Islands

i) Average Values for Resident Boat Fishermen

Based on discussion with key respondents and our follow-up procedure, the following information is considered representative of the non-market values that members of boat fishing clubs in the Hawaiian Islands associate with their fishing. To the extent that key respondents were unable to articulate cultural or commercial lifestyle values in dollar terms, they may not be complete. Table 8 presents a frequency distribution of non-market values associated with an hour's boat fishing by resident respondents.

Table 8Frequency Distribution of Non-Market Values Associated
with Boat Fishing by Hawaiian Residents

<u>Non-Market Value in Dollars/Hour</u>	<u>Number of Observations</u>
0	6
1	4
2	5
3	1
4	2
5	9
6	2
7	3
8	3
9	2
10	27
12	2
14	2
15	14
20	10
21	1
25	13
28	1
30	9
40	2
50	9
75	1
100	3
200	1
Total Observations	<u>132</u>

It can be observed that Table 8 has a modal value of \$10 per hour, and a median value of \$14 per hour. The distribution is slightly skewed to the right. In Table 9, information on hourly earnings and non-market value for resident boat fishing are presented, by club, island and state. Earnings are not provided by individual club for reasons of privacy.

Table 9

Earnings and Non-Market Values for Resident
Boat Fishermen in the Hawaiian Islands

<u>Area/Club</u>	<u>Average Earnings per Person \$/hr.</u>	<u>Average Non-Market Value Per Person \$/hr.</u>	<u>Standard Deviation of Non-Market Value \$/hr.</u>
State of Hawaii	19.89	20.08	19.11
Oahu	22.22	20.28	--
Aiea	--	10.83	3.76
Haleiwa	--	21.00	7.79
Honolulu	--	18.69	17.08
Mosquitos	--		
Kaneohe	--	27.86	32.10
Keehi	--	17.82	14.89
Pearl Harbor	--	15.00	6.12
Waialua	--	24.72	26.90
Big Island	16.97	23.00	--
Hilo Trollers	--	25.27	40.97
Kona Mauka	--	17.71	11.18
Maui	24.90	22.08	--
Maalaea	--	22.08	261.64
Maui Coop ⁽¹⁾	--	11.67	5.77
Kauai	13.08	7.30	--
Kukuiula	--	5.50	3.11
Westside	--	8.50	8.78

(1) Maui Coop is primarily interested in commercial fishing.

For some clubs, results are based on limited key respondent discussion, and would likely benefit from expanded discussion. This may also be true for one or more islands--particularly Kauai. Nonetheless, Table 9 provides useful first estimates of the value of an hour of sport fishing, over and above expenditures made for fishing.

As with information on trip expenditures, we believe these first estimates to be "representative" at the club level. They are relatively symmetrical, close to normally distributed, intuitively reasonable in terms of earning alternatives, and have been verified as "representative" by the clubs themselves. They can undoubtedly be improved, but costs associated with such improvement via formally structured intensive surveying could be extreme. They do not seem wildly divergent at the island or state level--save for Kauai--and should also be useful at those levels of aggregation. The fact that persons owning boats have earnings significantly greater than the minimum wage should also not be surprising.

Further analytical effort might be usefully targeted to Kauai. In fact, it is tempting, based on the Kauai information, to suggest that mean non-marketed values are positively related to level of income. Not enough discussion took place at the meetings on Kauai to reach such a conclusion. Rather, consideration of what underlying factors may influence non-market values of resident boat fishermen in the Hawaiian islands is best framed to consider the full range of information available for all four islands. This is done in the following section.

ii) Underlying Factors Affecting Values for Boat Fishermen in the Hawaiian Islands

In an attempt to identify whether particular demographic factors may predict the magnitude of non-market value for boat fishermen resident in the Hawaiian Islands, a step-wise multiple regression analysis was conducted relating non-market values for boat fishing to household income, amount spent on fishing, time spent on the water each trip, number of fish caught, number of years each person had fished in Hawaiian waters, number of boat trips taken each year and age of key respondent. This used the SPSS statistical package which provides a variety of statistical outputs to measure linear association between dependent and independent variables. The statistical measures reported here are described below.

- : R^2 = A measure of the goodness of fit, in a relationship between the non-market value of fishing and associated independent variables.
- : B_i = The slope of the regression line with respect to each independent variable i . Equivalent to the change in non-market fishing value per unit change of the independent variable i .
- : Beta = A measure of the relative importance of independent variables in the equation.
- : Signif.t = A measure of how significant the relationship is between independent variable i and fishing non-market value. Statistical convention usually ascribes a t value $\leq .05$ to a significant relationship between variables.

Results are reported in Table 10. In Step 1 of the table, all independent variables are included in the analysis. In progressive Steps 2 through 7, least significant independent variables are progressively removed. This focuses attention on remaining relatively

more important variables, and enhances their significance in the truncated equation. Eighty-five key responses were available to this analysis.

Table 10

Relative Relationship Between The Non-Market Value
of Boat Fishing for Residents of the Hawaiian
Islands, and other Selected Boater Characteristics

	Independent Variables Included	B_i	Beta	Signif. t
<u>Step 1 R^2</u> .32	- Household income	.0002	.117	.2997
	- Fishing expenses	-.0430	-.136	.2191
	- Time on water	.3279	.166	.1350
	- Fish caught	-.0015	-.083	.4620
	- Years of fishing	-.0085	-.004	.9703
	- Boat trips	-.0702	-.163	.1649
	- Age	.0713	.039	.7432
	- Constant	13.7917	--	.2961
<u>Step 2 R^2</u> .32	- Household income	.0002	.117	.2963
	- Fishing expenses	-.0431	-.136	.2107
	- Time on water	.3273	.166	.1322
	- Fish caught	-.0015	-.084	.4587
	- Boat trips	-.0702	-.163	.1614
	- Age	.0699	.038	.7426
	- Constant	13.7423	--	.2922
<u>Step 3 R^2</u> .32	- Household income	.0002	.125	.2492
	- Fishing expenses	-.0438	-.138	.2007
	- Time on water	.3185	.161	.1375
	- Fish caught	-.0015	-.087	.4342
	- Boat trips	-.0741	-.172	.1265
	- Constant	16.4118	--	.1067
<u>Step 4 R^2</u> .31	- Household income	.0002	.130	.2303
	- Fishing expenses	-.0425	-.134	.2127
	- Time on water	.3070	.156	.1500
	- Boat trips	-.0835	-.194	.0753
	- Constant	15.6952	--	.1202
<u>Step 5 R^2</u> .28	- Fishing expenses	-.0428	-.135	.2105
	- Time on water	.2816	.143	.1854
	- Boat trips	-.0894	-.207	.0568
	- Constant	25.5664	--	.0000
<u>Step 6 R^2</u> .24	- Time on water	.2775	.141	.1932
	- Boat trips	-.0842	.195	.0723
	- Constant	20.2069	--	.0000
<u>Step 7 R^2</u> .20	- Boat trips	-.0862	-.1998	.0669
	- Constant	23.6605	--	.0000

Interpretation of Table 10 should recall the manner in which underlying information was developed, and qualify results accordingly. What Table 10 shows, is that on the basis of the information available to us, we are unable to identify any statistically significant relationship between non-market values associated with resident fishing in the Hawaiian islands, and identified fishermen characteristics. If this finding is indicative, it increases our confidence about applying results more broadly to general boat populations in Hawaii.

g) Non-Market Values for Resident Shore Fishermen in Hawaii

i) Average Values for Resident Shore Fishermen

As noted earlier, information on shore fishermen has only been developed from two clubs on the Big Island. Again, no suggestion is made that the values reported here completely represent the commercial or cultural concerns of residents. A frequency distribution of average non-market values reported by key shore fishing respondents is presented in Table 11. Again these values are over and above fishing expenditures.

Table 11

Frequency Distribution of Non-Market Values
Associated with Shore Fishing by Big Island Residents

<u>Non-Market Value in</u> <u>Dollars per Hour</u>	<u>Number of</u> <u>Observations</u>
0	1
1	1
2	4
3	1
4	1
5	1
8	2
9	1
10	6
12	1
13	1
15	3
20	3
25	2
75	<u>1</u>
Total observations	29

Table 11 displays modal and median values of \$10, quite similar to that identified for boat fishermen in Table 8. The shore fishery value distribution is far less skewed to the right, however, so that there is less divergence of median and mean values. An examination of Table 12 will indicate that this is principally due to key responses from the Kona Casting Club. Key respondents from Hilo Casting Club provided information more in line with that from boat fishing respondents. The limited number of shore fishing key respondents overall (29) upon which we base our present information should also be noted. Again, earnings are not shown for individual clubs.

Table 12Earnings and Non-Market Values for Resident
Shore-Fishermen on the Big Island

<u>Area/Club</u>	<u>Average Earnings per Person \$/hr.</u>	<u>Average Non-Market Value per Person \$/hr.</u>	<u>Standard Deviation of Non-Market Value \$/hr.</u>
Hawaii	11.92	13.15	--
Hilo Casting	--	17.50	19.64
Kona Casting	--	6.62	4.84

In sum, we feel that the number of shore fishing clubs consulted was too few, and the divergence in value between the two clubs too great to generalize, concerning shore fishing value differences between clubs and islands, or between values for boat fishing and shore fishing. We believe that shore fishing values should consequently be further studied via expanded discussion with clubs on all islands.

ii) Underlying Factors Affecting Values for Shore
Fishermen in the Hawaiian Islands

While initial discussion with shore fishermen has been limited, it is nonetheless useful to report the Stepwise Linear Regression procedures already discussed for boat fishermen in Section (3, f, ii) above, to identify any clues that may assist further research. This information is displayed in Table 13, utilizing the same symbols defined on report page 32.

Table 13

Relative Relationship Between The Non-Market Value
of Shore Fishing on the Big Island, and Other Selected
Fishermen Characteristics

	<u>Independent Variables Included</u>	<u>B -i</u>	<u>Beta</u>	<u>Signif. t</u>
<u>Step 1 R²</u> .63	- Household income	.0006	.396	.3832
	- Number of trips	.0266	.064	.8704
	- Fishing expenses	-.1312	-.282	.4683
	- Years of fishing	.2315	.170	.6627
	- Fish caught	-.0296	-.220	.5467
	- Age	-.3801	-.223	.5671
	- Time spent fishing	.8203	.736	.1548
	- Constant	-5.9574	--	.8798
<u>Step 2 R²</u> .63	- Household income	.0006	.382	.3652
	- Fishing expenses	-.1357	-.292	.4239
	- Years of fishing	.1984	.146	.6690
	- Fish caught	-.0279	-.207	.5389
	- Age	-.3805	-.224	.5454
	- Time spent fishing	.7812	.701	.1133
	- Constant	-2.5466	--	.9358
<u>Step 3 R²</u> .62	- Household income	.0006	.390	.3367
	- Fishing expenses	-.1483	-.319	.3567
	- Fish caught	-.0266	-.198	.5399
	- Age	-.2226	-.131	.6469
	- Time spent fishing	.8364	.750	.0697
	- Constant	-5.5138	--	.8524
<u>Step 4 R²</u> .61	- Household income	.0005	.322	.3734
	- Fishing expenses	-.1228	-.264	.3963
	- Fish caught	-.0294	-.219	.4796
	- Time spent fishing	-.8020	.720	.0658
	- Constant	-10.6088	--	.6901
<u>Step 5 R²</u> .59	- Household income	.0007	.481	.0951
	- Fishing expenses	-.1524	-.328	.2658
	- Time spent fishing *	.9136	.820	.0244
	- Constant	-23.6277	--	.2246
<u>Step 6 R²</u> .53	- Household income *	.0007	.459	.1113
	- Time spent fishing *	.6796	.610	.0404
	- Constant	-25.6499	--	.1913
<u>Step 7 R²</u> .36	- Time spent fishing	.4024	.361	.1546
	- Constant	3.7206	--	.6279

* Significant relationship at the 95% confidence level.

The data in Table 13 suggest significant relationships between the non-market value of shore fishing and time spent fishing, but at relatively modest R^2 's for the overall equation. As with other data in this section, we view its primary usefulness to be in supplying clues for further investigation.

h) Marginal Values for Resident Boat and Shore Fishermen in the Hawaiian Islands

Key respondents were also asked what kind of a change in non-market values would occur if their catch per trip dropped by half.

If stocks of fish fell, so that your catch per trip dropped to half, of present levels would the value of an hour spent fishing for this reduced catch change from your answer to Question 8b?

	<u>\$/hr.</u>
1. Fair value for an hour of boat fishing with catch cut in half.	\$ _____

Only 57 key respondents from the 14 boat fishing clubs, and 12 respondents from the 2 shore fishing clubs responded to this enquiry. Again, pooling of boat fishing and shore fishing data, respectively, in the present context is vulnerable to non-homogenous characteristics between club groups. Nonetheless, results are reported as "first estimates" for marginal values associated with a 50 percent valuation in resident catch per trip in the Hawaiian Islands (Table 14).

Table 14

Estimates of Non-Market Value Lost Due to a Fifty
Percent Reduction in Catch Per Trip - Residents of
the Hawaiian Islands

<u>Type of Fishing</u>	<u>Number of Key Respondents #</u>	<u>Average Value \$/hr.</u>	<u>Value Lost- 50% Catch Loss \$/hr.</u>	<u>Ratio: Marginal to Average Value percent</u>
Boat Fishing	57	21.94	4.94	22.5
Shore Fishing	12	10.90	2.40	22.0

Economists recognize that these data are not sufficient to make extensive assertions about the slope of the marginal value curve. Viewed in terms of percentage loss associated with the 50 percent catch reduction, responses for the two groups are remarkably symmetrical, however. This gives us guarded confidence that the data developed here may be useful on a "first estimate" basis, and until more comprehensive data either confirms or improves upon it.

i) Non-Market Values for Resident Boat and Shore Fishing in
the Hawaiian Islands - A Summary

In sum, review of our key respondent procedures, and the non-market value results reported in Table 9, lead us to conclude that results are representative for boat fishing at a club level and provide usable first estimates by island for Oahu, the Big Island and Maui. We are less confident about our boating non-market values from Kauai, where information is based on limited discussion with two clubs, and is markedly different from the other islands. Similarly, our information on the non-market value of shore fishing comes from discussion with two clubs on the Big Island only--one of which indicated

representative values similar to those for Big Island boat fishing, while the other was quite a bit lower. We consequently recommend further work with boat fishermen on Kauai, and with shore fishermen throughout the Hawaiian Islands as a high priority. In the interim, we recommend use of a range of average boat fishing values on Kauai, between the \$13.08/hour value reported for the island in Table 9, and the \$16.97/hour reported for the Big Island. For shore fishing, we recommend sensitizing analysis using average club values for the Big Island of \$6.62/hour and \$17.50/hour (Table 12).

Marginal values reported here are based on more limited data. Both boat and shore fishermen seem consistent in reducing value per trip by 22.5 and 22.0 percent respectively, for a 50 percent reduction in catch. Such a result does not seem intuitively unreasonable, and we recommend that these percentages be applied to catch declines up to, but not exceeding the 50 percent level, until further information becomes available. It may also not be unreasonable to apply such percentage adjustments in value to discrete incremental enhancement of catch up to some cutoff level. That level would need to be determined by further work. Our intuition suggests it may lie between 25 percent and 100 percent above current catch levels³⁵.

35. The upper limit is based on evidence regarding recent declines in catch per unit of effort in Main Hawaiian Island fisheries. See Note 39, following.

4. Economic Values Associated with Resident Fishing by
Residents of the Hawaiian islands - An Aggregative Analysis

In this section, expenditures per trip and non-market values per hour of fishing will be expanded to estimate totals by island, and throughout the state of Hawaii. To achieve this result, it is first necessary to further stipulate trip duration, frequencies and numbers of persons involved for key respondent clubs.

a) Annual Number of Trips by Key Respondent

In our discussion with key respondents, we received the following indication of average fishing trip frequencies (Tables 15 and 16).

Table 15

Estimated Annual Number of Trips per Boat Fishing
Club Member - Residents of the Hawaiian Islands

<u>Area/Club</u>	<u>Average Annual Trips</u>			<u>Shore Fishing</u>
	<u>Own Boat Fishing</u>	<u>On Friend's Boat</u>	<u>Charter</u>	
<u>Oahu</u>	27	7	--	8
Aiea	22	14	--	8
Haleiwa	61	5	--	6
Honolulu	32	2	--	3
Mosquitos				
Kaneohe	15	7	1	8
Keehi	18	4	--	3
Pearl Harbor	46	2	--	29
Waialua	28	5	--	6
<u>Big Island</u>	31	6	--	11
Hilo Trollers	29	5	--	7
Kona Mauka	38	9	1	25
<u>Maui</u>	25	11	3	5
Maalaea	23	14	4	5
Maui Coop. (1)	34	2	--	2
<u>Kauai</u>	50	3	--	17
Kukuiula	54	5	1	25
Westside	45	1	--	7
<u>All Hawaiian Islands</u>	30	7	1	11

(1) This club primarily targets commercial fishing.

Table 16

Estimated Annual Number of Trips per Shore Fishing
Club Member - Residents of the Big Island

<u>Area/Club</u>	<u>Shore Fishing</u>	<u>Average Annual Trips</u>			<u>Boat Fishing</u>
		<u>On Friends</u>	<u>Boat</u>	<u>Charter</u>	
<u>Big Island</u>	24	--	--	--	--
Hilo Casting	22	--	--	--	--
Kona Casting	26	--	--	--	--

The data from Tables 15 and 16 appear lower than reported by SMS Research³⁶, although SMS's results fall within the higher range of numbers reported here. The more conservative information reported here shows considerable symmetry on an island by island basis - save on Kauai - and we feel more comfortable with it.

b) Number of Fishermen Hours Per Year

Key respondents for each club also indicated the average number of hours that club members fished, and the number of persons fishing per boat. This information is reported in Table 17.

35. SMS Research, op. cit.

Table 17

Total Hours Fished Per Trip, Residents of
the Hawaiian Islands

<u>Area/Club</u>	<u>Hours Fished</u>			<u>Persons⁽¹⁾</u> <u>Fishing</u> <u>Per Boat</u>	<u>Total Person</u> <u>Hours Per⁽²⁾</u> <u>Boat Trip</u>
	<u>Total/</u> <u>Trip</u>	<u>On the</u> <u>Water</u>	<u>At the</u> <u>Shore</u>		
<u>Oahu</u>	14	12	--	4	48
Aiea	16	12	--	4	48
Haleiwa	13	12	--	4	48
Honolulu	11	10	--	3	30
Mosquitos					
Kaneohe	12	11	--	4	44
Keehi	16	12	--	4	48
Pearl Harbor	11	10	--	4	40
Waialua	17	17	--	3	51
<u>Big Island</u>	13	10	--	3	30
(Boat)					
Hilo Trollers	13	10	--	3	30
Kona Mauka	11	9	--	3	27
<u>Big Island</u>	35	--	27	--	--
(Shore)					
Hilo Casting	41	--	33	--	--
Kona Casting	27	--	19	--	--
<u>Maui</u>	23	22	--	4	88
Maalaea	23	22	--	4	88
Maui Coop. (3)	40	40	--	3	120
<u>Kauai</u>	10	9	--	3	27
Kukuiula	10	8	--	4	32
Westside	10	9	--	2	18
<u>All Hawaiian</u>	18	15	--	4	60
<u>Islands (Boat)</u>					

(1) Including the captain. Not included in totals.

(2) Based on time on water only.

(3) Primarily a commercial fishing club.

c) Annual Expenditures Associated with Residents Fishing in the Hawaiian Islands

i) Boat Fishing

Calculation based on data from Skillman and Louie suggest that owners of 6,684 vessels obtained less than half their income from fishing³⁷. These owners would seem clearly to fall within the term "resident fishermen", utilized in this report. Of this total, approximately 1,200 fishermen are estimated to be on the Big Island, 500 on Kauai, 500 on Maui and 4,300 on Oahu. This compares to a 1983 estimate of 3,500 resident recreational vessels by SMS Research³⁸.

Utilizing the vessel inventory data, information from Tables 5-6, and from Table 15, it is now possible to estimate total annual expenditures in the state of Hawaii by resident boat fishermen. This is done in Table 18.

37. Skillman, Robert A. and David K.H. Louie, op. cit.

38. S.M.S. Research, op. cit.

Table 18Estimated Annual Expenditures-Resident Boat Fishermen
of the Hawaiian Islands

<u>Area</u>	<u>Estimated Boats</u>	<u>Average Trips/Yr.</u>	<u>Average Expenditures/Trip</u> \$	<u>Total Expenditures</u> \$'000
Oahu	4,278	27	103.93	12,005
Big Island	1,185	31	134.85	4,954
Maui	491	23	187.28	2,115
Kauai	536	50	115.42	3,093
State Total	6,684	30	120.01	24,064

As noted earlier, these figures do not include amortization of the boat. If the now conservative SMS Research figure of \$12 per trip were used for boat amortization, this would bring annual fishing expenditures by resident boat fishermen in the Hawaiian Islands to over \$26 million. This contribution to the state's economy includes direct expenditures only.

ii) Shore Fishing

Unfortunately, no estimate of the total number of resident shore fishermen in the Hawaiian Islands exists at present. We are consequently limited to assessing average expenditures per shore fishermen per year, but cannot extrapolate that to population estimates. Results per fishermen are reported for Hawaii in Table 19.

Table 19Estimated Annual Expenditure Per Shore
Fishermen on the Big Island

<u>Area</u>	<u>Average Trips/ Person/Yr. #</u>	<u>Average Personal Expenditures per Trip \$</u>	<u>Total Expenditures Per Person Per Year \$</u>
<u>Hawaii</u>			
Hilo	22	90.23	1,985
Casting			
Kona	26	53.16	1,382
Casting			

In considering these extrapolations, and those of the previous section, the methods by which this information has been assembled should again be recalled. As noted earlier, we feel fairly comfortable that our expenditure totals for boat fishermen represent reasonable estimates across the state boater population, but feel that information for shore fishermen will benefit from further development.

d) Annual Non-Market Values Associated With Resident
Fishing in the Hawaiian Islands

Proceeding as in the previous section, it is also possible to estimate the average value that fishermen resident in the Hawaii islands associate with their fishing, over and above what they actually spend on it. As noted, in a state such as Hawaii, where access to marine fishing at free or nominal charge is emphasized, inclusion of such non-market values is essential, if resource decision-making is to avoid distortion.

i) Boat Fishermen

Calculations for boat fishermen, based on vessel inventory estimates of boats, and Tables 9, 15, and 17, are presented in Table 20.

Table 20

Estimated Annual Non-Marketed Value Associated
with Fishing by Residents of the Hawaiian Islands

<u>Area</u>	<u>Estimated Boats</u>	<u>Estimated Annual Trips</u>	<u>Estimated Person Hrs. Per Trip</u> hrs.	<u>Estimated Value Per Person Hour</u> \$	<u>Total Non- Market Value</u> \$'000
Oahu	4,278	27	48	20.28	112,438
Big Island	1,185	31	30	23.00	25,347
Maui	491	23	88	20.12	19,995
Kauai	536	50	27	7.30	5,282
State Total	6,684	30	60	19.89	239,300

Considering Table 18, and Table 20 from the previous section, one can conclude that if the extrapolations used here are approximately valid, the marine fisheries of Hawaii provide more than \$260 million dollars in value annually to residents--not including values to commercial fishermen. Approximately \$24 million of this value flows into the economy each year via direct expenditures by fishermen. The remaining \$239 million flows as non-marketed "enjoyment" received by the people of Hawaii from fishing. While this enjoyment is not monetized, it is nonetheless real--and will be degraded or enhanced by decisions affecting Hawaii's marine fisheries.

It should also be noted that the non-market values discussed here are average values. When considering changes at the margin, readers are referred to Section (3, h), pp. 38-39.

ii) Shore Fishermen

Again, lack of an estimate of the full shore fishing population prevents an aggregated estimate of non-market value. On the Big Island, however, an estimate of annual non-market value received by a shore fishermen is possible. Such an estimate is presented in Table 21, using previous Tables 12, 16 and 17.

Table 21

Estimated Annual Non-Marketed Value Associated
with Shore Fishing on the Big Island

<u>Area</u>	<u>Average Trips/ Person/year</u>	<u>Average Hours Per Trip</u>	<u>Value Per Hour \$</u>	<u>Annual Non-Market Value/Person \$</u>
Hilo Casting	22	33	17.50	12,705
Kona Casting	26	19	6.62	3,270

5. Impact of Resident Fishing on Fish Markets in Hawaii

In discussions with key respondents, we also sought information on disposition of catch, the annual value of catch sold, and average price received at sale. Information on disposition of catch is provided in Table 22. Results for the nine "at large" key respondents on the windward side of Oahu are included.

Table 22

Disposition of Catch - Resident Fishermen
in the Hawaiian Islands

<u>Area/ Club</u>	<u>Own Consump.</u>	<u>Given Away</u>	<u>Sold at Market Price</u>	<u>Sold Below Market Price</u>	<u>Bait</u>	<u>Not Specified</u>
	-----percent-----					
<u>Oahu</u>	25.9	20.3	33.8	13.2	3.2	3.6
Aiea	27.7	24.4	23.5	24.4	--	--
Haleiwa	55.0	39.7	3.3	--	1.7	0.3
Honolulu	29.9	20.9	25.0	16.7	2.4	5.1
Mosquitos						
Kaneohe	31.2	15.5	37.2	4.1	1.8	10.2
Keehi	21.8	22.2	32.8	14.0	3.4	5.8
Pearl	12.0	9.0	63.0	13.0	1.0	2.0
Harbor						
Waialua	24.3	19.2	33.0	14.2	1.7	7.6
At large	6.0	34.6	50.0	0.4	3.2	5.8
<u>Big Island</u>	15.9	9.4	50.2	16.7	7.8	--
Boat						
Hilo	16.0	10.0	51.3	16.4	6.3	--
Trollers						
Kona Mauka	15.6	7.8	47.5	17.6	10.0	1.5
<u>Big Island</u>	31.9	41.0	3.3	5.6	7.1	11.1
Shore						
Hilo	37.2	40.8	2.2	1.9	8.3	9.6
Casting						
Kona	20.0	41.5	5.6	13.8	4.4	14.7
Casting						
<u>Maui (2)</u>	20.4	17.8	45.4	9.4	0.5	6.5
Maalaea	20.4	17.8	45.4	9.4	0.5	6.5
Maui	3.8	1.2	95.0	--	--	--
Coop (1)						
<u>Kauai</u>	15.9	19.0	33.7	18.4	5.8	7.2
Kukuiula	13.7	18.3	27.1	22.9	7.8	10.2
Westside	19.3	20.1	44.1	11.4	2.7	2.4
<u>Hawaiian Islands</u>	23.3	20.7	34.6	12.6	4.4	4.4

(1) This club focuses on commercial fishing and is excluded from totals.

(2) Based on Maalaea information only.

This information suggests that disposition of catch will vary with the particular characteristics of each club. Clearly, shore fishermen sell much less of their catch than do boat fishermen.

Key respondents also indicated the number of pounds of fish they felt each club member might sell in a year, and the average price received. This information is presented, by island, in Table 23, and extrapolated from sample to population using the vessel inventory estimate of resident vessels identified earlier (pg. 46). Estimates are based on the presumption that sales will accrue to the vessel owner. To the extent that club members obtain differing catches from boaters at large, this extrapolation would need to be adjusted.

Table 23
Estimated Volume and Value of Fish Sales - Resident
Fishermen in the Hawaiian Islands

<u>Island</u>	<u>Annual Sales/Person lbs.</u>	<u>Average Price \$/lb.</u>	<u>Total Value of Sales/ Person \$</u>	<u>Total Volume of Resident Sales '000 lbs.</u>	<u>Total Value of Resident Sales \$'000</u>
Oahu	966	2.34	2,260	4,133	9,671
Big Island-Boat	2,430	2.00	4,860	2,880	5,760
Maui	2,058	2.47	5,083	1,010	2,495
Kauai	2,183	1.80	3,929	1,170	2,106
Hawaiian Islands	1,508	2.21	3,333	10,079	22,275

If the estimates from Table 23 are even approximately accurate, the information we have gathered suggests that resident boaters in the Hawaiian Islands sell approximately 10 million pounds of fish annually at a value exceeding \$22 million dollars. These sales would be in addition to catches provided by full-time commercial fishermen. The speculative nature of this estimate should be emphasized. When compared to total fishery landings indicated for Hawaii³⁹ of 9.6 million pounds worth \$14.8 million in 1984 (the latest year of complete record), one would conclude that catches by the resident boaters featured in this report make up the greatest part of total market supply, that catch statistics presently under-report resident boater sales by a significant margin, or that the extrapolations provided here are in error. Further pursuit of this issue would seem an important priority for research.

6. Motivations Associated With Resident Fishing in the Hawaiian Islands

Key respondents were asked to indicate the range of motivations that lead residents of the Hawaiian Islands to go fishing. These motivations are arrayed by island, and on a statewide basis, in Table 24.

39. National Marine Fisheries Service, Fishery Statistics of the Western Pacific, Volume I, Southwest Fisheries Center Admin. Report H-86-4, Honolulu, March, 1986.

Table 24

Motivations for Fishing by Residents
of the Hawaiian Islands

<u>Motivation</u>	<u>All Islands</u>	<u>Oahu</u>	<u>Big Island</u>	<u>Maui</u> ⁽¹⁾	<u>Kauai</u>
	-----percent of respondents-----				
Excitement of catching fish	70.6	73.6	79.4	61.3	58.3
Having fun	67.2	66.7	77.9	67.7	62.5
A chance to eat fresh fish	61.8	58.1	57.4	77.4	79.2
Getting away from tensions and frustrations	61.1	65.1	66.2	41.9	58.3
Being with family or friends	51.1	55.0	51.5	54.8	33.3
A chance to earn extra money	37.4	31.0	39.7	29.0	54.2
Important part of living in the Hawaiian Islands	24.4	19.4	23.5	35.5	29.2
Being close to nature	22.5	24.0	25.0	22.6	16.7
Competition with other fishermen	22.5	28.7	23.5	9.7	8.3
Self-achievement	20.2	17.8	23.5	16.1	25.0
A way to stay healthy	20.2	24.0	10.3	22.6	25.0
Fishing is part of my culture	17.2	12.4	11.8	29.0	29.2

(1) Based on Maalaea data only.

7. Catches by Resident Fishermen in the Hawaiian Islands

Key respondents also provided estimates of catches for 1985. We are less confident concerning the accuracy of these statistics than some others in our report. Problems associated with species recognition and memory bias⁴⁰ will affect reported results. Further, some key respondents identified catch in pounds, requiring conversion to pieces using average weights. Average weights used in conversions are identified in Appendix I. Reported catch for major species are presented in Table 25.

Table 25
Principal Species Caught Per Hawaiian Islands
Resident Fishermen - 1985

<u>Species</u>	<u>Oahu</u>	<u>Big Island</u>	<u>Maui⁽¹⁾</u>	<u>Kauai</u>
	-----fish per year-----			
Akule	67	1	--	140
Aku	69	68	28	130
Opakapaka	62	16	144	8
Mahimahi	23	14	7	1
Weke ula	20	--	--	3
Papio	15	3	14	2
Opelu	15	1	7	52
Menipachi	14	29	1	8
Onaga	13	11	92	27
Ahi	12	109	25	35
Taape	11	5	--	--
Uku	9	--	96	102
Ono	7	25	8	4
Ulua	1	9	--	--
Marlin	3	4	1	.5
Ehu	6	9	--	34
Lobster	--	8	--	--

(1) Based on Maalaea information only.

40. For a discussion in a fisheries context, see: Abramson, N.J., "Distribution of California Angling Effort in 1961", California Fish and Game, Vol. 49, No.3, July, 1963; Frankel, L.R., The Role of Accuracy and Precision of Response in Sample Surveys. Audits and Surveys, Inc. 1969.

We do not believe it possible, on the basis of this information, to estimate total catch for resident fishermen. It is possible, referencing Tables 22 and 23, to estimate total resident boat fishing catch from each island as follows:

$$(1) TC = \frac{S}{P_m}$$

where;

TC = total estimated annual catch, in pounds;

S = total volume of fish sold at or below market price, in pounds, from Table 23;

P_m = the proportion of total annual catch sold at or below market price, from Table 22.

These inferential calculations are provided in Table 26. It is likely that further comparative work with other data bases is required before a definitive conclusion as to accuracy could be reached.

Table 26

Inferential Estimates of Total Annual Catch
by Hawaiian Island Resident Boat Fishermen

<u>Island</u>	Total Sales Volume '000 lbs.	Proportion of Catch Sold	Total Estimated Catch '000 lbs.
Oahu	4,133	.47	8,794
Big Island	2,880	.67	4,298
Mau i	1,010	.55	1,836
Kauai	1,170	.52	2,250
Hawaiian Islands	10,079	.47	21,445

Key respondents also provided information on recent trends they have observed in fisheries around the Hawaiian islands. In Table 27, declines in average size of fish caught on each island are shown in Column (1), with an indication of the median year this change was observed in Column (2). In Table 28, net change in catch by species is recorded.

Table 27

Observed Declines in Sizes of Fish Caught -
Hawaiian Resident Fishermen

Species	Oahu		Big Island		Maui		Kauai	
	Decline	Median	Decline	Median	Decline	Median	Decline	Median
	in Size lbs.	Year Noticed yr.	in Size lbs.	Year Noticed yr.	in Size lbs.	Year Noticed yr.	in Size lbs.	Year Noticed yr.
Ahi	48	1982	34	1982	--	--	38	1982
Aku	6	1983	5	1983	4	1971	--	--
Akule	2	1982	--	--	--	--	2	1984
Mahimahi	8	1982	4	1984	8	--	--	--
Marlin	104	1983	107	1983	250	1979	--	--
Ono	11	1982	10	1983	--	--	8	1980
Opakapaka	4	1982	3	1985	3	1982	--	--
Ulua	12	1980	18	1984	40	1975	18	1984

Table 28Observed Changes in Numbers of Fish Caught Per
Day - Hawaiian Resident Fishermen

<u>Species</u>	<u>Oahu</u> <u>Change</u> <u>in</u> <u>Catch</u> <u>fish</u>	<u>Big Island</u> <u>Change</u> <u>in</u> <u>Catch</u> <u>fish</u>	<u>Maui</u> <u>Change</u> <u>in</u> <u>Catch</u> <u>fish</u>	<u>Kauai</u> <u>Change</u> <u>in</u> <u>Catch</u> <u>fish</u>
Ahi	-2	-4	+4	-16
Aku	-8	+6	--	+30
Akule	-83	-1	--	-105
Mahimahi	+1	+2	+1	--
Marlin	-1	-2	--	--
Ono	-1	-1	+1	-2
Opakapaka	-2	-5	--	--
Opelu	-1	--	--	--
Papio	-1	-2	--	--
Taape	+24	--	+5	+90
Uku	--	--	--	--
Ulua	-24	-1	--	-3
Weke ula	+2	--	--	--

The information in Table 27 shows a considerable level of inter-island consistency for most species, although the year declines were observed varies somewhat. In an area such as Hawaii, where identification of fishery trends is often both difficult and expensive, such indicator information may be useful, and should be further explored. Information in Table 28 is substantially incomplete and no obvious conclusions emerge from its examination.

Key respondents were also asked whether they were travelling further to catch their fish than they used to, if so, how much further, and when this change occurred. Results are presented in Table 29.

Table 29

Changing Travel Time Associated with Resident
Fishing in the Hawaiian Islands

<u>Area/Club</u>	<u>Traveling Further</u>		<u>How Much Further (Mean) ---miles---</u>	<u>When Started⁽¹⁾ (Median) -----year-----</u>
	<u>Yes</u>	<u>No</u>		
	-percent-	-percent-		
<u>Oahu</u>	85.6	14.4	21	1982
Aiea	91.7	8.3	35	1983
Haleiwa	100.0	--	18	1984
Honolulu	81.2	18.8	15	1983
Mosquitos				
Kaneohe	84.2	15.8	20	1984
Keehi	81.2	18.8	16	1981
Pearl Harbor	100.0	--	12	1984
Waialua	88.9	10.1	20	1981
At large	77.8	22.2	42	1982
<u>Big Island - Boat</u>	74.2	25.8	12	1983
Hilo Trollers	73.9	26.1	12	1984
Kona Mauka	75.0	25.0	13	1980
<u>Big Island - Shore</u>	59.3	40.7	39	1983
Hilo Casting	53.3	46.7	47	1983
Kona Casting	66.7	33.3	30	1980
<u>Maui</u>	43.3	56.7	18	1982
Maalaea	41.7	58.3	18	1980
Maui Coop.	50.0	50.0	21	1984
<u>Kauai</u>	38.1	61.9	18	1984
Kukuiula	30.8	69.2	9	1984
Westside	50.0	50.0	26	1978
Hawaiian Islands	70.5	29.5	21	1983

8. Accessing Locations for Fishing in the Hawaiian Islands

Finally, resident fishermen were asked about the areas they fish from in summer and winter seasons. Results are presented in Table 30. Only locations accounting for 20 percent or more of total activity, by club, are identified in the table.

Table 30

Access Locations for Resident Fishermen
in the Hawaiian Islands

<u>Area/Club</u>	<u>Summer Season</u>		<u>Winter Season</u>	
	<u>Location</u>	<u>Percent of Responses</u> %	<u>Location</u>	<u>Percent of Responses</u> %
<u>Oahu</u>				
Aiea	Waianae	31	Hawaii Kai	38
	Haleiwa	23	Waianae	23
	Keehi	23	Sand Island	23
Haleiwa	Haleiwa	80	Haleiwa	67
Honolulu	Waianae	33	Maunalua Bay	27
Mosquitos	Maunalua Bay	20	Hawaii Kai	20
			Waianae	20
Kaneohe	Kaneohe Y.C.	81	Kaneohe Y.C.	81
Keehi	Keehi	64	Keehi	75
	Waianae	29		
Pearl	Pokai Bay	40	Pearl Harbor	50
Harbor	Waianae	40	Hawaii Kai	25
	Pearl Harbor	20	Koko Head	25
Waialua	Haleiwa	85	Haleiwa	67
<u>Big Island - Boat</u>				
Hilo	Hilo	55	Hilo	56
Trollers	Wailoa	25	Wailoa	28
Kona Mauka	Keauhou	43	Honokohau	50
	Honokohau	29		
<u>Big Island - Shore</u>				
Hilo	Kau	38	Kau	27
Casting	Kona	25	Hilo	20
Kona	Kona	40	Kona	50
Casting	South Kona	20	South Kona	20
	North	20		
<u>Maui</u>				
Maalaea	Maalaea	69	Maalaea	75
Maui Coop.	Maalaea	88	Maalaea	86
<u>Kauai</u>				
Kukuiula	Kukuiula	54	Kukuiula	62
	Port Allen	23		
Westside	Port Allen	88	Port Allen	88

V. Perceptions of Hawaiian Islands Resident Fishermen on Issues Affecting Fishing in Hawaii

1) Facilities

Key respondents also expressed their views on the adequacy of facilities in Hawaii. In this section, facility requirements will be identified on an island by island basis. These data are presented in Tables 31 through 34. Facility concerns are represented on a scale, with an index number of 100 assigned to the harbor-facility requirement most often cited by respondents. Other harbor-facility combinations are then assigned lesser index numbers. Numbers thus indicate relative intensity of concern.

Table 31Facilities Needed at Harbors on Oahu

<u>Facilities</u>	<u>Harbor</u>					
	<u>Haleiwa</u>	<u>Heeia</u>	<u>Hawaii</u>			<u>Sand</u>
	<u>Small Boat</u>	<u>Kea</u>	<u>Kai</u>	<u>Keahi</u>	<u>Wainae</u>	<u>Island</u>
	-----	index	numbers	of requirements	-----	-----
Gas facilities available or open longer	100.0	14.3	14.3	50.0	42.9	7.1
More or improved launch ramps	50.0	42.9	42.9	--	--	21.4
Boat wash down fac.	85.7	14.3	35.7	7.1	7.1	14.3
Lights for launching	78.6	--	64.3	--	--	14.3
Security Guard	71.4	35.7	14.3	14.3	14.3	7.1
Better/more parking	21.4	71.4	42.9	21.4	--	7.1
Better washup fac.	42.9	21.4	--	28.6	--	14.3
Better breakwalls	7.1	--	--	--	21.4	--
Fresh water faucets	--	--	7.1	21.4	--	--
Lights on breakwater	28.6	7.1	7.1	7.1	--	--
More anchoring/ mooring area	21.4	7.1	--	--	--	--

(cont'd on page 68)

Table 31 Cont'd

Facilities Needed at Harbors on Oahu

<u>Facilities</u>	<u>Harbor</u>				
	<u>Maunaloa</u> <u>Bay</u>	<u>Pokai</u> <u>Bay</u>	<u>Kaneohe</u> <u>Yacht Club</u>	<u>Portlock</u>	<u>Kewalo</u>
	-----index numbers of requirements-----				
Gas facilities available or open longer	--	14.3	7.1	--	--
More or improved launch ramps	14.3	7.1	7.1	7.1	--
Boat wash down fac.	21.4	7.1	--	--	--
Lights for launching	14.3	--	14.3	14.3	--
Security Guard	14.3	7.1	14.3	--	14.3
Better/more parking	7.1	7.1	7.1	7.1	--
Better washup fac.	14.3	--	--	7.1	7.1
Better breakwalls	7.1	14.3	--	--	--
Fresh water faucets	--	7.1	7.1	7.1	--
Lights on breakwater	--	--	--	--	--
More anchoring/ mooring area	--	--	14.3	--	--

Table 32Facilities Needed at Harbors on the Big Island

<u>Facilities</u>	<u>Harbor</u>				
	<u>Hilo</u>	<u>Wailoa</u>	<u>Honakahau</u>	<u>Keahou</u>	<u>Hilo</u> <u>Wailea</u>
	-----index numbers of requirements-----				
More or improved ramps	100.0	33.3	--	33.3	22.2
Better/more parking	66.7	44.4	33.3	44.4	11.1
Boat wash down fac.	33.3	11.1	22.2	22.2	11.1
Gas facilities available or open longer	33.3	11.1	11.1	--	--
More anchoring/mooring area	22.2	22.2	--	11.1	11.1
More docks/slips	11.1	22.2	22.2	--	--
Better washup fac.	11.1	--	22.2	--	11.1
Better breakwalls	11.1	--	11.1	11.1	--
Fresh water faucets	22.2	--	--	--	--

Table 33Facilities Needed at Harbors on Maui

<u>Facilities</u>	<u>Harbor</u>	
	<u>Maalaea</u>	<u>Lahaina</u>
	<u>-index numbers of requirements-</u>	
Better breakwalls	100.0	--
More anchoring/mooring area	72.7	--
Gas facilities available/ open longer	36.4	27.3
Better washup facilities	18.2	27.3
More/better parking	27.3	9.1
Electrical outlets	36.4	--
More docks/slips	36.4	--
More area for dry dock	18.2	9.1
Better dredging	9.1	--
Lights on breakwater	18.2	--
More/improved launch ramps	--	18.2

Table 34Facilities Needed at Harbors on Kauai

<u>Facilities</u>	<u>Harbor</u>	
	<u>Port Allen</u>	<u>Kukuiula</u>
	<u>-index numbers of requirements-</u>	
Security Guard	100.0	--
Better/more parking	57.1	71.4
Better breakwalls	--	57.1
Fresh water faucets	--	42.9
Permanent gas facilities on the dock; drive up gas facilities on the highway	28.6	--
Icehouse	28.6	--
Maintain Telephone(s)	28.6	--
Lights for launching	14.3	14.3
Better/improved ramps	14.3	14.3

It is possible that greater success in contacting the Pokai Bay Club would have increased relative priorities in the Wainae/Pokai Bay area. Similarly, facility needs at Hana are not identified, nor are some harbors on Kauai. Nonetheless, Tables 31 through 34 represent a useful first prioritization of facility needs on each island.

2. Fishing Techniques

Key respondents also discussed what fishing methods were, in their view, damaging to fishers, and should not be allowed. Results are presented, by island, in Table 35. There seems to be a general pre-disposition against netting offshore, but opinion is more mixed on prohibition of netting close to shore.

Table 35
Fishing Methods that Should Not Be Allowed
in Hawaiian Waters

<u>Island</u>	<u>Near Shore Fishing</u>		<u>Off-Shore Fishing</u>	
	<u>Method</u>	<u>Percent of Responses</u>	<u>Method</u>	<u>Percent of Responses</u>
Oahu	Netting	50.0	Netting	62.8
	Commercial diving	10.6		
Big Island	Netting	37.0	Netting	38.9
Maui	Netting	31.2	Netting Spotter Plane	75.0 10.5
	Commercial diving	18.8		
Kauai	Netting	52.9	Netting	70.6

3. Kapuku Zoning

The State of Hawaii has been utilizing an ancient Hawaiian approach to foreshore management by establishing a "Kapuku" management system for fisheries in the Waikiki-Diamond Head area on Oahu. Under this system, initiated in 1978, the near shore fishing area is alternatively opened to fishing and then closed, on a two year rotating basis. Key respondents commented on the Waikiki-Diamond Head Kapuku system, and on whether kapuku systems should be tried in other areas of the Hawaiian Islands. Results are presented, by island, in Table 36.

Table 36Club Views on Kapuku Zoning in the Hawaiian Islands

<u>Island</u>	<u>Waikiki-Diamond Head</u>			<u>Other Areas</u>		
	<u>A good</u> <u>Program</u>	<u>Not a Good</u> <u>Program</u>	<u>No</u> <u>Opinion</u>	<u>Should</u> <u>Proceed</u>	<u>Should not</u> <u>Proceed</u>	<u>No</u> <u>Opinion</u>
-----percent of responses-----						
Oahu	79.4	2.0	18.6	72.3	9.9	17.8
Big Island	38.5	17.9	43.6	38.3	23.4	38.3
Maui	43.8	6.2	50.0	53.8	15.4	30.8
Kauai	75.0	--	25.0	75.0	6.2	18.8

4. The Whale Sanctuary Issue

Key respondents also addressed the whale sanctuary issue. Results follow in Tables 37 and 38.

Table 37Resident Fishermen's Views on Their Exclusion from Whale Sanctuaries

<u>Island</u>	<u>Agree</u>	<u>Don't Agree</u>
----percent of responses--		
Oahu	41.3	58.7
Big Island	41.5	58.5
Maui	34.6	65.4
Kauai	38.1	61.9

Table 38Principal Comments Concerning the Whale Sanctuary Issue

<u>Comment</u>	<u>Percent of Total Responses</u> %
1. A sanctuary isn't necessary; fishermen and whales can co-exist	47.1
2. Do what is necessary to save the whales	23.5
3. Ban harassment of whales by tour boats, and by foreign fishing	12.9
4. Fishermen avoid whales	12.9

5. Fish Aggregating Devices (FAD's)

Finally, key respondents were asked whether Fish Aggregating Devices (FAD's) improved their catch. Most club respondents felt they did. Results are presented in Table 39.

Table 39Resident Fishermen's Opinion of FAD's in the
Hawaiian Islands

<u>Island</u>	<u>Believe FAD's Improve Catch</u> -----percent-----	<u>Do Not Believe FAD's Improve Catch</u> -----percent-----
Oahu	80.2	19.8
Big Island	76.1	23.9
Maui	71.0	29.0
Kauai	88.9	11.1

* Several fishermen indicated that FAD's should be properly illuminated, so as not to become navigation hazards after dark.

VI. Conclusions and Recommendations for Future Research

This report, provides a broad array of new information concerning fishing clubs in the Hawaiian Islands. It is only a first step in required quantification, however. Data developed on trip characteristics and fishing expenditures appear fairly solid and indicate that resident fishermen make a significant contribution to the economy of the State of Hawaii. Data on non-market values provide new insight into the importance of island fisheries, and indicate that fishing provides major benefits beyond those registered in the market place. The conceptual approach taken for non-market valuation is reasonable, and the results intuitively plausible--but choice of product size (ie. recreation hour, vs. recreation day, vs. trip) may be significant in determining the result obtained. We recommend more research in this area.

This study also tested the key respondent method, and the potential of fishing clubs as information sources in the Hawaiian Islands. We conclude that both prospects are promising. Key respondent procedures have resulted in considerable consistency of response across fishing clubs and islands, and we consider this approach to have promise, particularly for some types of information. Further, the fishing clubs themselves display considerable knowledge over a variety of fishing areas, and club-related data retrieved on a regular basis may prove a highly beneficial and cost effect prospect. These opportunities should likewise be pursued.

Finally, during this survey, we experimented with development of biological information, such as analysis of size distribution for selected species, from lay observation. No clear conclusions seem evident at this time. We would recommend, however, that such investigations be continued on a more problem-specific basis.

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Appendix I
Table Converting Pounds to Pieces -
Fish Catches by Residents of
the Hawaiian Islands

Table of Conversion

Pounds of Fish to Pieces of Fish

<u>Fish</u>	<u>Pounds Per One Fish</u>
Ahi	114.50
Aku	3.83
Akule	2.75
Billfish	150.00
Blue Marlin	188.30
Kumu	1.81
Mahimahi	32.10
Ono	25.46
Opakapaka	3.65
Opelu	.50
Snapper	4.00
Tunas	3.25
Uku	6.10

Source:

These figures were developed from answers to questions about changing fish sizes, put to key club respondents during the information gathering process.

